

2012 MCAS Exam Test Items

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Test item alignment to
Energy 1: Integrating Sciences through Energy
Questions 8, 9, 13, 15, 18, 25, 28, 35 & 45 directly align.

XX. Introductory Physics, High School

High School Introductory Physics Test

The spring 2012 high school Introductory Physics test was based on learning standards in the Physics content strand of the Massachusetts *Science and Technology/Engineering Curriculum Framework* (2006). These learning standards appear on pages 74–77 of the *Framework*.

The *Science and Technology/Engineering Curriculum Framework* is available on the Department website at www.doe.mass.edu/frameworks/current.html.

Introductory Physics test results are reported under the following four MCAS reporting categories:

- Motion and Forces
- Heat and Heat Transfer
- Waves and Radiation
- Electromagnetism

Test Sessions

The high school Introductory Physics test included two separate test sessions, which were administered on consecutive days. Each session included multiple-choice and open-response questions.

Reference Materials and Tools

Each student taking the high school Introductory Physics test was provided with an Introductory Physics Formula Sheet. A copy of this formula sheet follows the final question in this chapter.

Each student also had sole access to a calculator with at least four functions and a square-root key.

The use of bilingual word-to-word dictionaries was allowed for current and former English language learner students only, during both Introductory Physics test sessions. No other reference tools or materials were allowed.

Cross-Reference Information

The table at the conclusion of this chapter indicates each item's reporting category and the framework learning standard it assesses. The correct answers for multiple-choice questions are also displayed in the table.

Introductory Physics

SESSION 1

DIRECTIONS

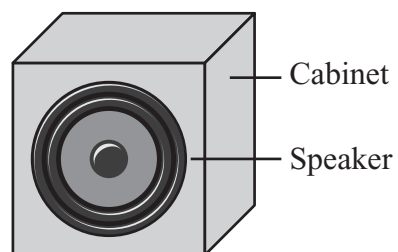
This session contains twenty-one multiple-choice questions and two open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

- 1 A rock is dropped from a window 5 m above the ground. The rock hits the ground 1.0 s later with a speed of 10 m/s.

What is the average speed of the rock during this time?

- A. 5 m/s
- B. 8 m/s
- C. 15 m/s
- D. 50 m/s

- 2 The picture below shows a sound speaker in a cabinet with its front panel removed.



When music plays through the speaker, the speaker rapidly moves back and forth in the cabinet. Which of the following conclusions is **best** supported by this observation?

- A. Sound travels only in air.
- B. Sound is a transverse wave.
- C. Sound is a longitudinal wave.
- D. Sound travels at the speed of light.

- 3 A person pushes a heavy cabinet across a level wooden floor. Force X is the force required to start the cabinet moving. Force Y is the force required to maintain a slow, steady forward motion.

Which of the following statements describes the two forces, X and Y?

- A. Force X is added to force Y.
- B. Force X is less than force Y.
- C. Force X is unrelated to force Y.
- D. Force X is greater than force Y.

- 4 Which of the following statements **best** describes a difference between mechanical waves and electromagnetic waves?

- A. Mechanical waves can produce colored light, while electromagnetic waves cannot.
- B. Mechanical waves can travel in any direction, while electromagnetic waves travel only in one direction.
- C. Mechanical waves travel only through a medium, while electromagnetic waves can also travel through a vacuum.
- D. Mechanical waves travel only at the speed of light, while electromagnetic waves can travel at many different speeds.

- 5 According to Newton's law of universal gravitation, in which of the following situations does the gravitational attraction between two bodies **always** increase?

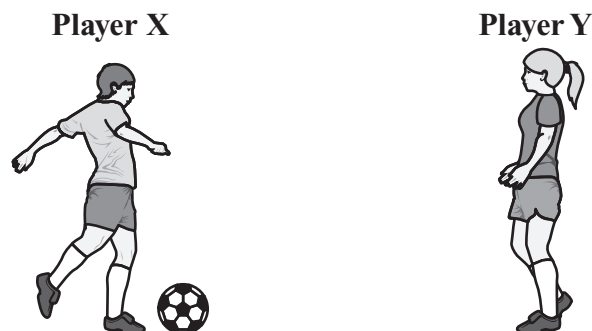
- A. The masses increase, and the distance between the centers of mass increases.
- B. The masses increase, and the distance between the centers of mass decreases.
- C. The masses decrease, and the distance between the centers of mass increases.
- D. The masses decrease, and the distance between the centers of mass decreases.

- 6 A student is sitting on the edge of a swimming pool. The student repeatedly dips his foot in and out of the pool, making waves that move across the water. The student dips his foot slowly at first and then does it faster, each time to the same depth.

Which of the following properties of the waves **increases** as the student dips his foot faster?

- A. frequency
- B. period
- C. velocity
- D. wavelength

- 7 Two soccer players, X and Y, are kicking a ball back and forth to each other, as shown below.



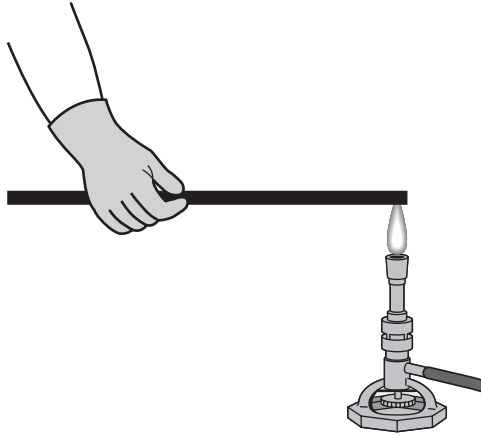
The table below shows the distance and direction the ball moves after each of four kicks.

Kick	Player	Distance and Direction
1	X	5 m right
2	Y	4 m left
3	X	6 m right
4	Y	5 m left

What is the total displacement of the ball and the total distance traveled by the ball?

- A. The ball has a displacement of 2 m to the right and traveled a distance of 20 m.
- B. The ball has a displacement of 20 m to the right and traveled a distance of 2 m.
- C. The ball has a displacement of 9 m to the right and traveled a distance of 11 m.
- D. The ball has a displacement of 11 m to the right and traveled a distance of 9 m.

- 8 An iron bar is placed in a flame, as shown below, and is heated until the end glows.



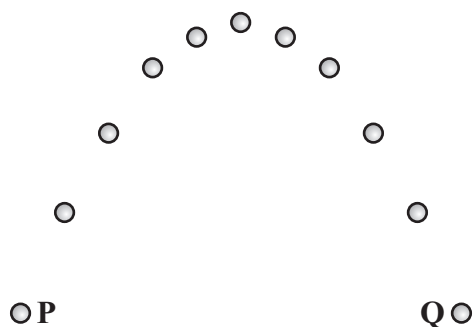
The other end of the iron bar soon becomes hot, too. Which of the following statements **best** describes what happens?

- A. A convective flow of energy is set up inside the iron bar.
- B. Energy is conducted from atom to atom along the length of the iron bar.
- C. Radiation moves through the iron bar and is absorbed by the end not in the flame.
- D. Air heated by the flame radiates down the iron bar and heats the end not in the flame.

- 9 An inventor claims to have designed a perpetual motion machine, a device that creates its own power. Which of the following laws **best** explains why a perpetual motion machine cannot work?

- A. law of conservation of energy
- B. law of conservation of matter
- C. Newton's second law
- D. Newton's third law

- 10 A ball is thrown upward at an angle from position P. The diagram below shows the position of the ball at equal time intervals as it moves from position P to position Q.



Which of the following causes the change in the ball's velocity as the ball travels from position P to position Q?

- A. decrease in its inertia
- B. increase in its momentum
- C. downward force of gravity
- D. initial acceleration upward

- 11 A battery is connected to a light bulb with copper wire to complete a circuit. The bulb immediately lights.

Which of the following **best** describes why the bulb lights?

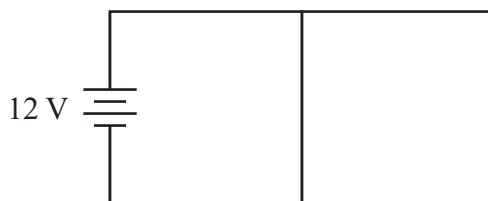
- A. The battery supplies electrons, which move through the bulb but not the wire.
- B. The battery supplies chemicals, which pass through the bulb to the end of the wire.
- C. The battery supplies heat energy, which causes the bulb to produce light energy.
- D. The battery supplies voltage, which causes electrons throughout the circuit to move.

Question 12 is an open-response question.

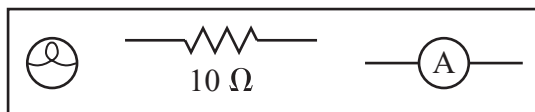
- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 12 in the space provided in your Student Answer Booklet.

- 12** The diagram below shows an incomplete parallel circuit and the components that will complete the circuit.



Circuit Components



- In your Student Answer Booklet, draw the parallel circuit using all the circuit components shown. Place the ammeter in the circuit so that it measures the total current of the circuit.
- Calculate the current flowing through the resistor. Show your calculations and include units in your answer.

When the circuit is operating, the ammeter measures a total current of 1.5 A.

- Determine the resistance of the light bulb. Show your calculations or explain your reasoning. Include units in your answer.
- Describe **one** change that would result if the light bulb and resistor were placed in series instead of in parallel.

Mark your answers to multiple-choice questions 13 through 22 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

- 13 A cup of tea with a temperature of 80°C is placed on a table in a 20°C room. What happens to the thermal energy and molecular motion of the tea when it is left on the table?

- A. The thermal energy increases and the molecules move faster.
- B. The thermal energy decreases and the molecules move faster.
- C. The thermal energy increases and the molecules move more slowly.
- D. The thermal energy decreases and the molecules move more slowly.

- 14 Which of the following statements explains why light is refracted as it moves from air into glass?

- A. The speed of light decreases in glass.
- B. The energy of light increases in glass.
- C. The frequency of light decreases in glass.
- D. The wavelength of light increases in glass.

- 15 A hand-held video game is powered by batteries. After playing the game for several minutes, a student notices that the game feels warm.

Which of the following is the **most likely** explanation for this observation?

- A. The game creates energy when it is turned on.
- B. Some of the energy from the batteries is changed to heat.
- C. Some of the energy from the batteries is changed to friction.
- D. The game receives heat energy from the person playing it.

16 An object with a mass of 3 kg has a momentum of $75 \text{ kg} \cdot \text{m/s}$. What is its velocity?

- A. 0.4 m/s
- B. 7.1 m/s
- C. 25 m/s
- D. 72 m/s

17 Which of the following actions would increase the electric force between two positively charged particles?

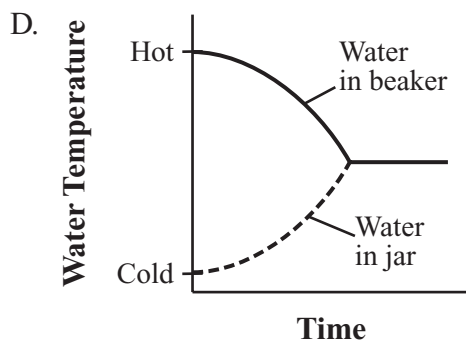
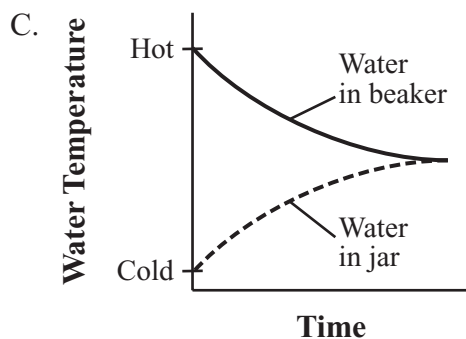
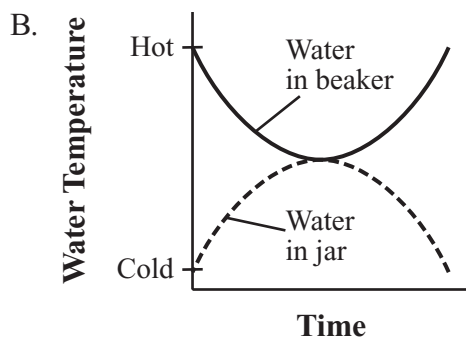
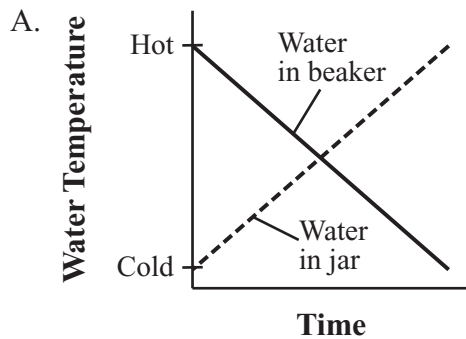
- A. decreasing the mass of the particles
- B. decreasing the distance between the particles
- C. changing the charges from positive to negative
- D. transferring all the charge from one particle to the other

- 18 A small body of water contains 2,000 kg of water. The specific heat of water is $4,180 \text{ J/kg} \cdot ^\circ\text{C}$.

If the temperature of the water changes from 25°C to 20°C , approximately how much heat moves from the water to the surroundings?

- A. 8,400,000 J
- B. 42,000,000 J
- C. 168,000,000 J
- D. 210,000,000 J

- 19 A sealed glass jar containing 200 mL of cold water is lowered into a large beaker containing 200 mL of hot water. Which of the following graphs shows how the temperature of each water sample will most likely change over time?



- 20 A 1000 kg automobile is traveling at an initial speed of 20 m/s. It is brought to a complete stop in 5 s over a distance of 50 m.

What is the work done in stopping the automobile?

- A. 10,000 J
B. 40,000 J
C. 50,000 J
D. 200,000 J

- 21 A rope is stretched horizontally between two students. One of the students shakes an end of the rope up and down. Which of the following terms **best** describes the type of wave that is produced?
- A. electromagnetic
 - B. longitudinal
 - C. rotational
 - D. transverse
- 22 The siren of a fire truck emits a certain pitch, which is heard by a nearby observer. In which of the following situations would the observer perceive the lowest frequency of sound?
- A. The observer and fire truck are both stationary.
 - B. The observer walks at 3 m/s toward the stationary fire truck.
 - C. The observer is stationary while the fire truck drives toward the observer at 15 m/s.
 - D. The observer is stationary while the fire truck drives away from the observer at 15 m/s.

Question 23 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 23 in the space provided in your Student Answer Booklet.

23 A 30.0 N force is continuously applied to the right on a 12.0 kg object. The object accelerates on a horizontal frictionless surface. After a certain amount of time, another force of 8.0 N is applied to the left on the object.

- Calculate the object's acceleration **before** the 8.0 N force is applied. Show your calculations and include units in your answer.
- Calculate the object's acceleration **after** the 8.0 N force is applied. Show your calculations and include units in your answer.
- Is the direction of acceleration in parts (a) and (b) the same or different? Explain your answer.

The object is then pushed onto a slightly rough surface that exerts an additional 20 N frictional force to the left on the object.

- Will the object come to rest on the slightly rough surface? Explain your answer.

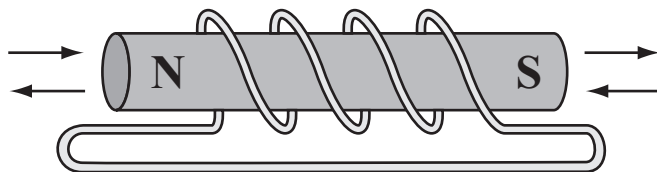
Introductory Physics

SESSION 2

DIRECTIONS

This session contains nineteen multiple-choice questions and three open-response questions. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

- 24 The diagram below shows a bar magnet within a coil of conducting wire. The magnet is moved back and forth. The magnet never has contact with the wire.



As the magnet is moved, the wire will

- A. decrease in temperature.
- B. become negatively charged.
- C. demagnetize the bar magnet.
- D. have an electric current.

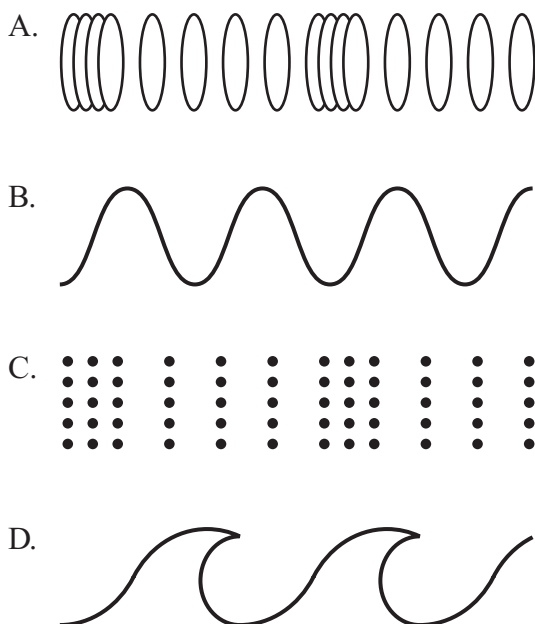
- 25 The table below provides information about the daily use of some typical appliances.

Appliance	Power Rating (W)	Duration of Use (hr)
dishwasher	1500	0.5
air conditioner	1000	1.0
laptop computer	50	12.0
clock radio	1	24.0

Which appliance uses the most energy?

- A. dishwasher
- B. air conditioner
- C. laptop computer
- D. clock radio

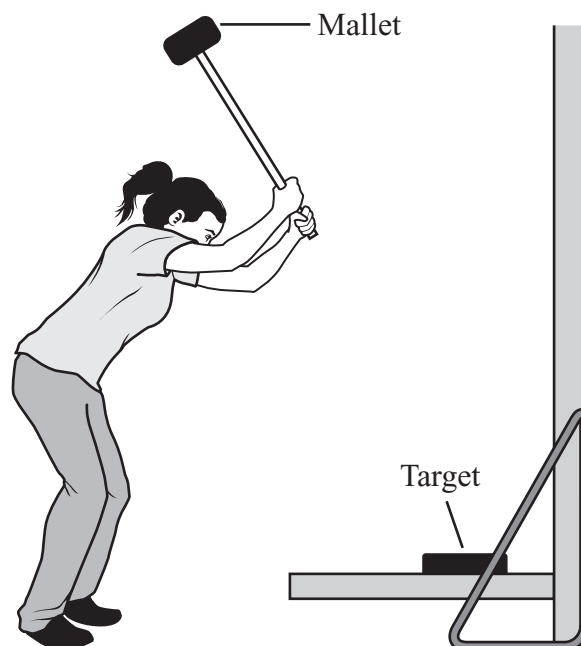
- 26 Which of the following **best** represents an electromagnetic wave?



- 27 A simple circuit has a current of 3.0 A and a resistance of 5.0 Ω . What is the voltage supplied by the battery of this circuit?

A. 0.60 V
B. 1.7 V
C. 8.0 V
D. 15.0 V

- 28 While playing a game at a fair, a person lifts a mallet above her head. She then lets the mallet fall toward a target, as shown below.



Which of the following statements describes an energy change that takes place as the person lifts the mallet and then lets it fall toward the target?

- A. Kinetic energy increases as the mallet reaches its highest point.
B. Potential energy decreases as the mallet reaches its highest point.
C. Kinetic energy converts to potential energy as the mallet falls toward the target.
D. Potential energy converts to kinetic energy as the mallet falls toward the target.

- 29 Student X and student Y are receiving sound waves from a stationary source. The sound waves have a frequency of 10 kHz. Student X is stationary and student Y is traveling toward the source of the sound waves.

Which of the following statements describes what will happen as student Y moves?

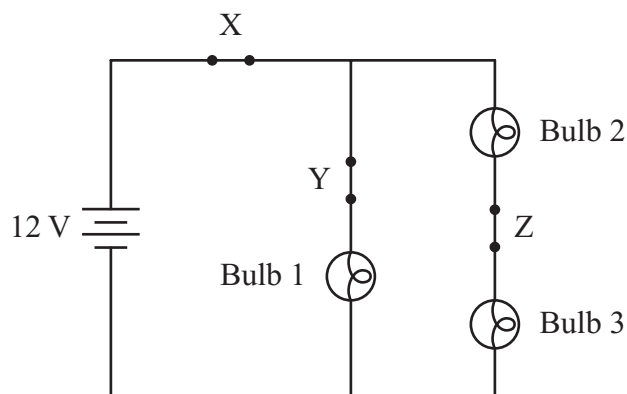
- A. Student X will receive sound waves with a frequency higher than 10 kHz.
- B. Student X will receive sound waves with a frequency lower than 10 kHz.
- C. Student Y will receive sound waves with a frequency higher than 10 kHz.
- D. Student Y will receive sound waves with a frequency lower than 10 kHz.

- 30 A student rubs a glass rod with a piece of cloth and rubs a plastic ruler with a different piece of cloth. The glass rod becomes positively charged, and the ruler becomes negatively charged.

Which of the following statements describes the **most likely** result when the two pieces of cloth are brought close to each other?

- A. The pieces of cloth repel each other.
- B. The pieces of cloth attract each other.
- C. A continuous current flows between the pieces of cloth.
- D. There is no electric interaction between the pieces of cloth.

- 31 The diagram below shows an electrical circuit with three bulbs and three switches. The switches are labeled X, Y, and Z. When all three switches are closed, as shown, all three bulbs are lit.



Which of the following statements describes what will happen if switch Z is opened?

- A. Only bulb 1 will be lit.
- B. Only bulb 3 will be lit.
- C. All three bulbs will be lit.
- D. None of the bulbs will be lit.

Question 32 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 32 in the space provided in your Student Answer Booklet.

32 When fireworks explode, they create light waves and sound waves. An investigation is performed to study the differences between the two types of waves. Three cameras capable of recording audio and video are set up at safe nearby locations in clear view of the fireworks.

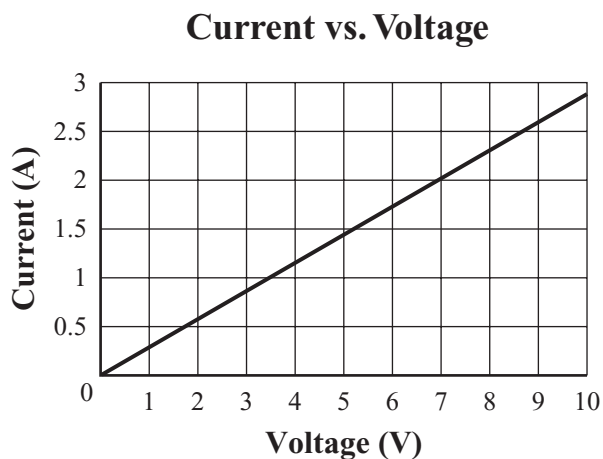
- Camera 1 is placed in an open field.
 - Camera 2 is placed in a vacuum-sealed glass container.
 - Camera 3 is placed behind sheets of polarizing glass that block electromagnetic waves.
- a. Identify whether audio only, video only, or both audio and video of the fireworks will be recorded by **each** camera.
- b. Explain **each** of your answers for part (a).

Suppose a camera records both audio and video.

- c. Will the light or the sound from the fireworks be recorded first? Explain your answer.

Mark your answers to multiple-choice questions 33 through 43 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

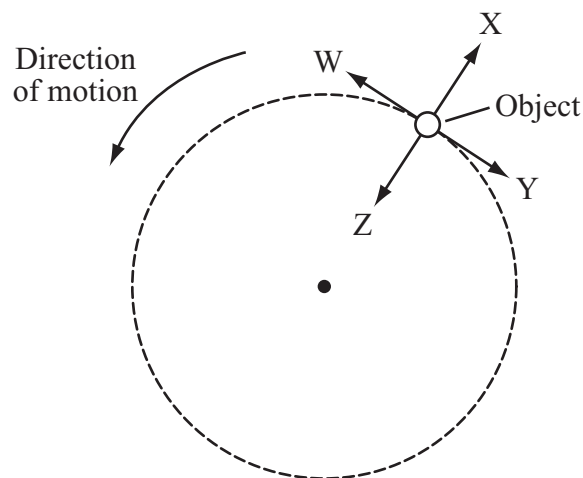
- 33 The graph below shows the relationship between current and voltage in a circuit. Resistance in the circuit remains constant.



What is the resistance of this circuit?

- A. $0.3 \, \Omega$
- B. $2.5 \, \Omega$
- C. $3.5 \, \Omega$
- D. $30 \, \Omega$

- 34 The diagram below shows an object traveling at a constant speed in a circular path.



Which labeled arrow represents the centripetal force acting on the object?

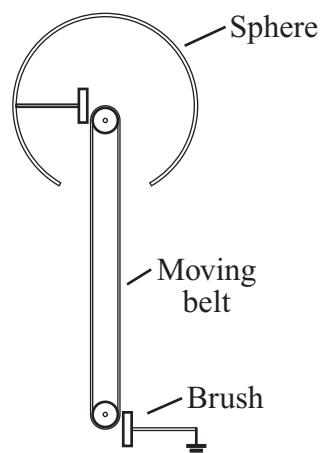
- A. W
- B. X
- C. Y
- D. Z

- 35 Popcorn is made by heating corn kernels. Different methods may be used to heat the kernels.

Which of the following methods uses radiation as the primary means of transferring energy to the corn kernels?

- A. heating corn kernels in a hot air popper
- B. heating corn kernels in a microwave oven
- C. heating corn kernels in a foil pan on a hot plate
- D. heating corn kernels in oil in a pot on an electric stove

- 36 The diagram below shows the inside of a Van de Graaff generator.

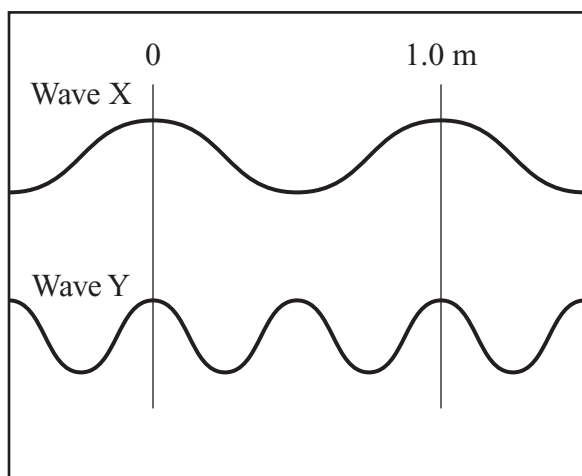


A net charge can be built up on the generator's sphere. A moving belt removes charged particles from the sphere and deposits them on the brush. Charged particles flow freely over the surface of the sphere, but do not move on the belt.

The generator could be made from which of the following?

- A. a copper belt and a plastic sphere
- B. a rubber belt and a plastic sphere
- C. a copper belt and an aluminum sphere
- D. a rubber belt and an aluminum sphere

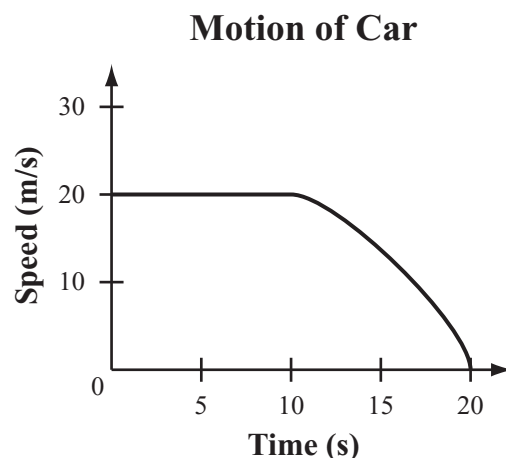
- 37 Two waves traveling in the same medium are shown below.



Which of the following correctly compares the two waves?

- A. Wave X has half the amplitude of wave Y.
- B. Wave X has twice the amplitude of wave Y.
- C. Wave X has a lower frequency and longer wavelength than wave Y.
- D. Wave X has a higher frequency and shorter wavelength than wave Y.

- 38 The graph below represents the motion of a car as it moves along a straight road for 20 s.



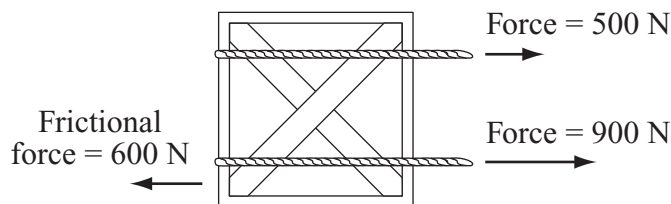
Which statement **best** describes the motion of the car over the 20 s?

- A. The car is initially at rest and then backs up for 10 s.
- B. The car moves 20 m in the first 10 s and then stops.
- C. The car travels at a constant speed for 10 s and then decelerates until it stops.
- D. The car travels at a constant speed of 20 m/s and then decelerates until it is traveling at a constant speed of 15 m/s.

- 39 A 20 kg child is traveling 3 m/s on an amusement park ride. What is the magnitude of the child's momentum?

A. $6.7 \text{ kg} \cdot \text{m/s}$
B. $60 \text{ kg} \cdot \text{m/s}$
C. $90 \text{ kg} \cdot \text{m/s}$
D. $200 \text{ kg} \cdot \text{m/s}$

- 40 A crate is being pulled along a floor by means of two ropes. A frictional force opposes the motion of the crate. The diagram below shows these three forces acting on the crate.



What is the magnitude of the net force acting on the crate?

A. 800 N
B. 1000 N
C. 1400 N
D. 2000 N

- 41 Ultraviolet and x-ray radiation can damage human cells. Which of the following is a property of these two forms of radiation?

A. low wave speed
B. short wavelength
C. low wave frequency
D. small wave amplitude

- 42 In which of the following media do sound waves **most likely** travel the fastest?

A. crude oil
B. distilled water
C. solid steel
D. warm air

- 43 A car is moving at 25 m/s north. Which of the following is a vector quantity?

A. the speed of the car
B. the velocity of the car
C. the potential energy of the car
D. the distance traveled by the car

Questions 44 and 45 are open-response questions.

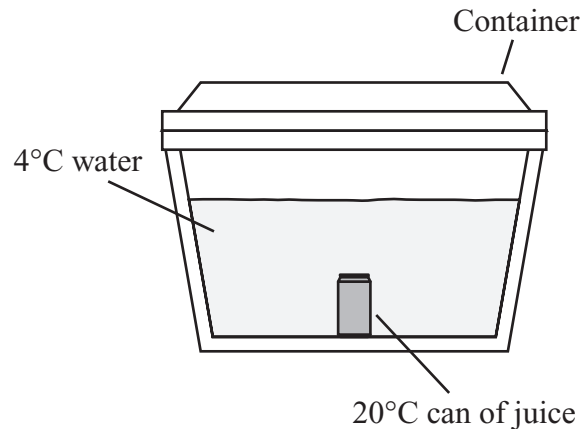
- **BE SURE TO ANSWER AND LABEL ALL PARTS OF EACH QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 44 in the space provided in your Student Answer Booklet.

- 44** A student lifts a 10.0 kg box from the floor at a constant speed to a shelf that is 1.5 m above the floor.
- Construct a free-body force diagram that represents the forces acting on the box when it is 1.0 m above the floor. Be sure to label your diagram.
 - Explain how you know that work is being done on the box, and how the work results in a change in the energy of the box.
 - Calculate the amount of work done on the box and the change in potential energy of the box. Show your calculations and include units in your answer.

Write your answer to question 45 in the space provided in your Student Answer Booklet.

- 45 A can of juice at 20°C is completely submerged in a closed, insulated container filled with water at 4°C , as shown in the diagram below.



- Describe what happens to the temperature of the can of juice **and** the temperature of the water in the container within the first few minutes after the can is submerged. Explain your answer.
- After four hours, will the can and the water have the same temperature or different temperatures? Explain your answer.
- Estimate the numerical value(s) of the final temperatures of the can of juice and the water after four hours. Explain your answer.

Massachusetts Comprehensive Assessment System

Introductory Physics Formula Sheet

Formulas

$$\text{Average Speed} = \frac{d}{\Delta t}$$

$$F = ma$$

$$p = mv$$

$$\text{Average Acceleration} = \frac{\Delta v}{\Delta t}$$

$$F = G \frac{m_1 m_2}{d^2}$$

$$V = IR$$

$$\text{Average Velocity} = \frac{\Delta x}{\Delta t}$$

$$F = k \frac{q_1 q_2}{d^2}$$

$$P = IV$$

$$v_f = v_i + a\Delta t$$

$$KE = \frac{1}{2}mv^2$$

$$Q = mc\Delta T$$

$$\Delta x = v_i \Delta t + \frac{1}{2}a \Delta t^2$$

$$PE = mg\Delta h$$

$$v = f\lambda$$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$W = Fd$$

$$\lambda = \frac{c}{f}$$

$$\text{Average Velocity} = \frac{v_i + v_f}{2}$$

$$P = \frac{W}{\Delta t}$$

$$T = \frac{1}{f}$$

Variables

a = acceleration	q = charge of particle
c = specific heat	Q = heat
d = distance	R = resistance
f = frequency	Δt = change in time
F = force	ΔT = change in temperature
Δh = change in height	T = period
I = current	v = velocity
KE = kinetic energy	v_i = initial velocity
λ = wavelength	v_f = final velocity
m = mass	Δv = change in velocity
p = momentum	V = voltage
P = power	W = work
PE = gravitational potential energy	Δx = displacement

Definitions

$$c = \text{speed of electromagnetic waves} = 3.00 \times 10^8 \text{ m/s}$$

$$G = \text{Universal gravitational constant} = 6.67 \times 10^{-11} \frac{\text{N} \cdot \text{m}^2}{\text{kg}^2}$$

$$k = \text{Coulomb constant} = 8.99 \times 10^9 \frac{\text{N} \cdot \text{m}^2}{\text{C}^2}$$

$$g \approx 10 \text{ m/s}^2 \quad 1 \text{ N} = 1 \frac{\text{kg} \cdot \text{m}}{\text{s}^2} \quad 1 \text{ J} = 1 \text{ N} \cdot \text{m} \quad 1 \text{ W (watt)} = 1 \frac{\text{J}}{\text{s}}$$

High School Introductory Physics
Spring 2012 Released Items:
Reporting Categories, Standards, and Correct Answers*

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC)*
1	361	<i>Motion and Forces</i>	1.2	A
2	361	<i>Waves and Radiation</i>	4.3	C
3	362	<i>Motion and Forces</i>	1.6	D
4	362	<i>Waves and Radiation</i>	4.2	C
5	363	<i>Motion and Forces</i>	1.7	B
6	363	<i>Waves and Radiation</i>	4.1	A
7	363	<i>Motion and Forces</i>	1.2	A
8	364	<i>Heat and Heat Transfer</i>	3.1	B
9	364	<i>Motion and Forces</i>	2.1	A
10	365	<i>Motion and Forces</i>	1.4	C
11	365	<i>Electromagnetism</i>	5.5	D
12	366	<i>Electromagnetism</i>	5.3	
13	367	<i>Heat and Heat Transfer</i>	3.3	D
14	367	<i>Waves and Radiation</i>	4.4	A
15	367	<i>Motion and Forces</i>	2.1	B
16	368	<i>Motion and Forces</i>	2.5	C
17	368	<i>Electromagnetism</i>	5.4	B
18	369	<i>Heat and Heat Transfer</i>	3.4	B
19	370	<i>Heat and Heat Transfer</i>	3.2	C
20	370	<i>Motion and Forces</i>	2.3	D
21	371	<i>Waves and Radiation</i>	4.3	D
22	371	<i>Waves and Radiation</i>	4.6	D
23	372	<i>Motion and Forces</i>	1.4	
24	373	<i>Electromagnetism</i>	5.6	D
25	373	<i>Motion and Forces</i>	2.4	B
26	374	<i>Waves and Radiation</i>	6.1	B
27	374	<i>Electromagnetism</i>	5.2	D
28	374	<i>Motion and Forces</i>	2.2	D
29	375	<i>Waves and Radiation</i>	4.6	C
30	375	<i>Electromagnetism</i>	5.1	B
31	375	<i>Electromagnetism</i>	5.3	A
32	376	<i>Waves and Radiation</i>	4.2	
33	377	<i>Electromagnetism</i>	5.2	C
34	377	<i>Motion and Forces</i>	1.8	D
35	378	<i>Heat and Heat Transfer</i>	3.1	B
36	378	<i>Electromagnetism</i>	5.1	D
37	379	<i>Waves and Radiation</i>	4.1	C
38	379	<i>Motion and Forces</i>	1.3	C
39	380	<i>Motion and Forces</i>	2.5	B

Item No.	Page No.	Reporting Category	Standard	Correct Answer (MC)*
40	380	<i>Motion and Forces</i>	1.5	A
41	380	<i>Waves and Radiation</i>	6.2	B
42	380	<i>Waves and Radiation</i>	4.5	C
43	380	<i>Motion and Forces</i>	1.1	B
44	381	<i>Motion and Forces</i>	2.3	
45	382	<i>Heat and Heat Transfer</i>	3.2	

* Answers are provided here for multiple-choice items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's website later this year.